College of Agriculture and Home Economics
THE OHIO STATE UNIVERSITY

EVALUATING PROPOSED CAPITAL INVESTMENTS

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EVALUATING PROPOSED CAPITAL INVESTMENTS

DECISIONS - DECISIONS - DECISIONS

CAPITAL INVESTMENT DECISIONS MAY WELL BE THE MOST IMPORTANT JUDGMENTS UNDERTAKEN BY MANAGEMENT.

IMPORTANCE

U.S. FARM CAPITAL PURCHASES

$35 BILLION - 1979 EST.

INDIVIDUALLY

$1,000 - $1,000,000 +

DIFFICULTIES

EXPENDITURES

CURRENT

LUMPY

BENEFITS

FUTURE

PREDICTIVE ABILITY

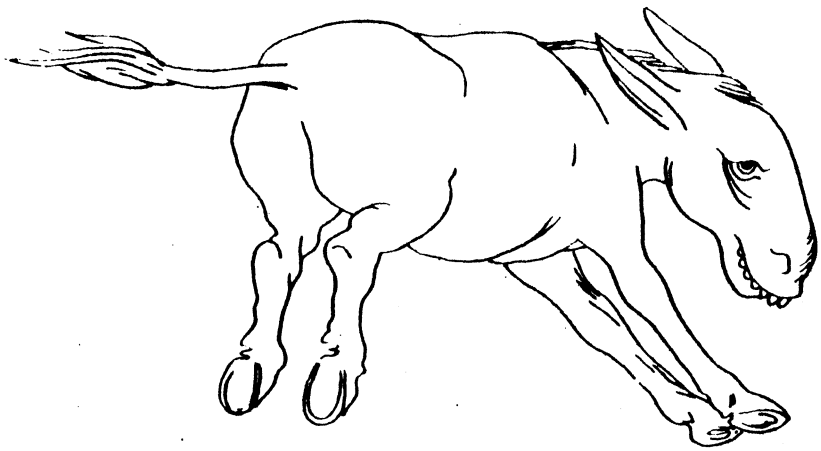
COSTS - RETURNS

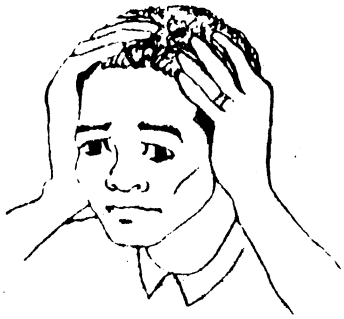
5 - 10 - 20 YEARS

METHOD OF ANALYSIS

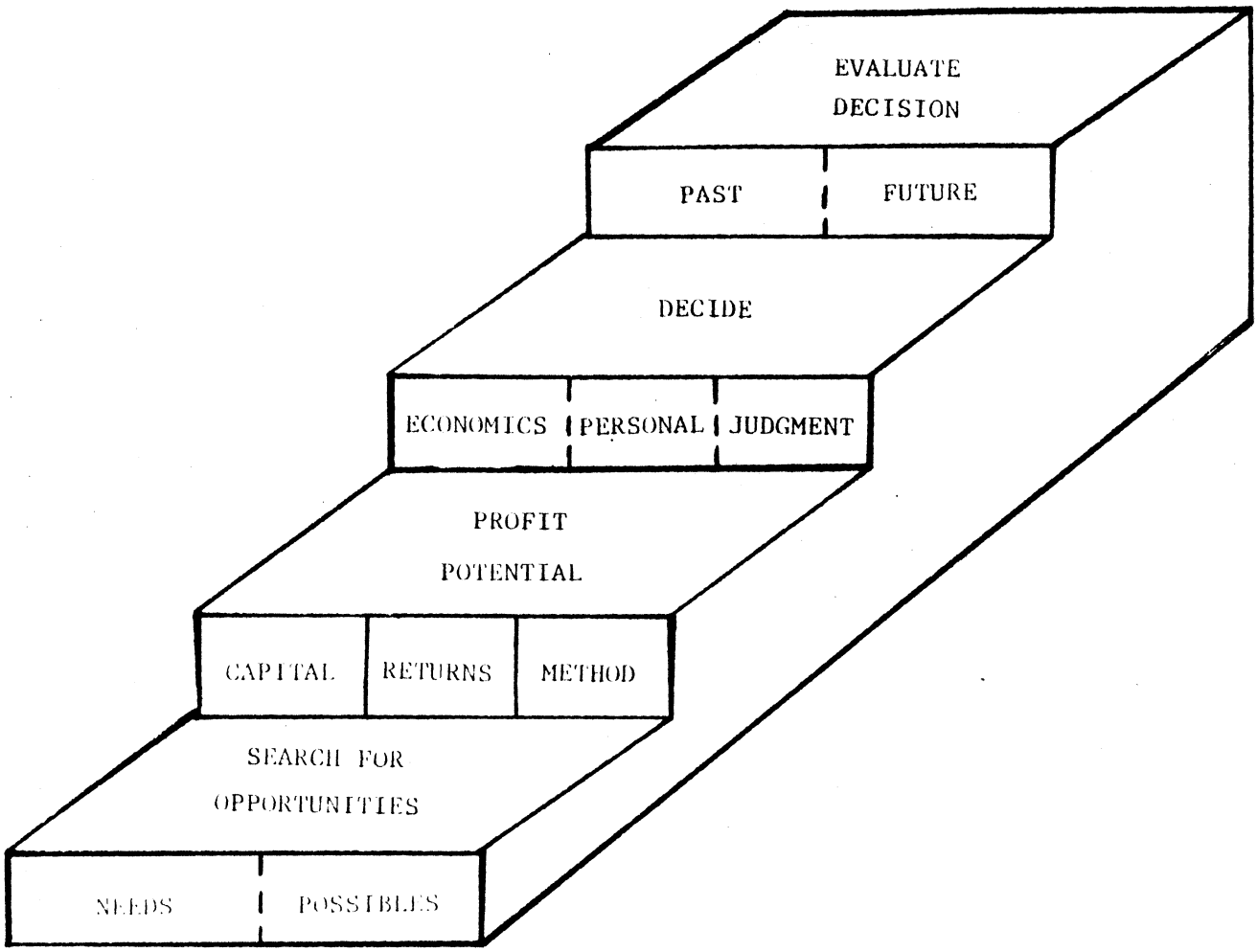
ECONOMICALLY SOUND

USEABLE





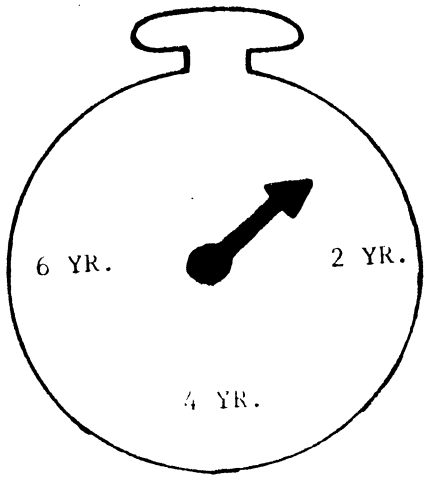
DECISIONS ON CAPITAL EXPENDITURES ARE AMONG THE MOST DIFFICULT MANAGERIAL DECISIONS.



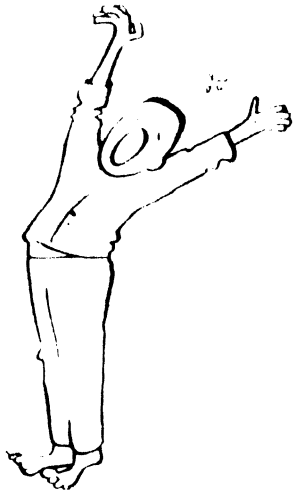
MAJOR STEPS IN EVALUATING CAPITAL

EXPENDITURE PROPOSALS.

ROI

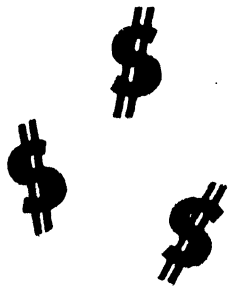


PAYBACK



URGENCY

MORE
VALUABLE
THAN



IN HAND

IN FUTURE

PAYBACK AND ROI HAVE A

SERIOUS LIMITATION

COMMONLY USED MEASURES OF

INVESTMENT WORTH

NET PRESENT VALUE

INFLATION

UNCERTAINTY

ALTERNATIVE USE

IMPORTANT

TIME VALUE OF MONEY

TIME VALUE OF MONEY

DOES MONEY HAVE TIME VALUE?

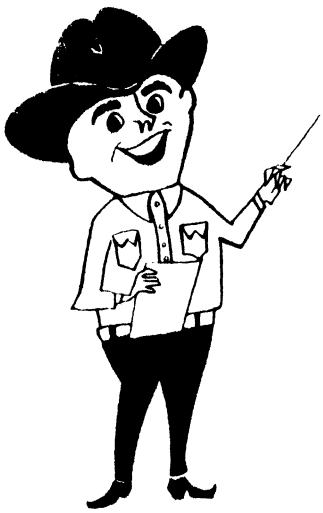
BUSINESS PREFERS TODAY'S DOLLAR

TIME VALUE HAS THREE COMPONENTS (T)

1. ALTERNATIVE USE (A)
   - FROM INVESTMENT OPPORTUNITIES
   - EARNING POTENTIAL
   - MONEY BEGETS MONEY
   - DISCOUNT CASH FLOW TO COMPARE TODAY'S $
2. RISK AND UNCERTAINTY (R)
   - UNCERTAIN WORLD
   - MORE DISTANT FUTURE MORE UNCERTAIN
   - UNCERTAINTY VARIES
3. INFLATION (I)
   - CONTINUED INFLATION
   - TOMORROW'S $ WILL BUY LESS THAN TODAY'S $
   - PRICES AND COSTS

PRESENT VALUE: WHAT IS IT?

ANOTHER NAME --- DISCOUNTED CASH FLOW



"PRESENT VALUE OF $100
PAYABLE IN 5 YEARS IS
THAT AMOUNT OF MONEY
NEEDED TO INVEST TODAY
AT COMPOUND INTEREST
IN ORDER TO HAVE $100
IN 5 YEARS."

$1 INVESTED TODAY AT 10%

YEAR	FUTURE VALUE
1	1.10
2	1.21
5	1.54
10	2.59
20	6.73
40	45.26

COMPOUNDING

TODAY'S $ GROW INTO FUTURE $

$ RECEIVED IN FUTURE AT 10%

YEAR	VALUE RECEIVED	VALUE PRESENT
1	$ 1.10	$1
2	1.21	1
5	1.61	1
10	2.59	1
20	6.73	1
40	45.26	1

PRESENT VALUE

FUTURE $ DISCOUNTED TO TODAY'S $

PRESENT VALUE FACTORS

	DISCOUNT RATES		
YEAR	5	10	15
1	.9524	.9091	.8696
2	.9070	.8264	.7561
5	.7835	.6209	.4972
10	.6139	.3855	.2472
20	.3769	.1486	.0611
40	.1420	.0221	.0037

DISCOUNT FACTORS/ PRESENT VALUE FACTORS

"VALUE OF $1 RECEIVED IN FUTURE

AT A DISCOUNT RATE"

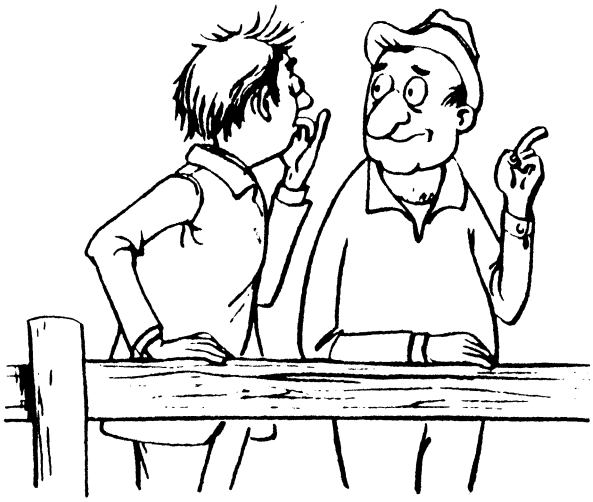
Table 11

Present Value of $1 [1/]

$(1+r)^{-n}$

Year (n)	1%	2%	3%	4%	5%	6%	7%
1	0.9901	0.9804	0.9709	0.9615	0.9524	0.9434	0.9346
2	0.9803	0.9612	0.9426	0.9246	0.9070	0.8900	0.8734
3	0.9706	0.9423	0.9151	0.8890	0.8638	0.8396	0.8163
4	0.9610	0.9238	0.8885	0.8548	0.8227	0.7921	0.7629
5	0.9515	0.9057	0.8626	0.8219	0.7835	0.7473	0.7130
6	0.9420	0.8880	0.8375	0.7903	0.7462	0.7050	0.6663
7	0.9327	0.8706	0.8131	0.7599	0.7107	0.6651	0.6228
8	0.9235	0.8535	0.7894	0.7307	0.6768	0.6274	0.5820
9	0.9143	0.8368	0.7664	0.7026	0.6446	0.5919	0.5439
10	0.9053	0.8203	0.7441	0.6756	0.6139	0.5584	0.5083
11	0.8963	0.8043	0.7224	0.6496	0.5847	0.5268	0.4751
12	0.8874	0.7885	0.7014	0.6246	0.5568	0.4970	0.4440
13	0.8787	0.7730	0.6810	0.6006	0.5303	0.4688	0.4150
14	0.8700	0.7579	0.6611	0.5775	0.5051	0.4423	0.3878
15	0.8613	0.7430	0.6419	0.5553	0.4810	0.4173	0.3624
16	0.8528	0.7284	0.6232	0.5339	0.4581	0.3936	0.3387
17	0.8444	0.7142	0.6050	0.5134	0.4363	0.3714	0.3166
18	0.8360	0.7002	0.5874	0.4936	0.4155	0.3503	0.2959
19	0.8277	0.6864	0.5703	0.4746	0.3957	0.3305	0.2765
20	0.8195	0.6730	0.5537	0.4564	0.3769	0.3118	0.2584
21	0.8114	0.6598	0.5375	0.4388	0.3589	0.2942	0.2415
22	0.8034	0.6468	0.5219	0.4220	0.3418	0.2775	0.2257
23	0.7954	0.6342	0.5067	0.4057	0.3256	0.2618	0.2109
24	0.7876	0.6217	0.4919	0.3901	0.3101	0.2470	0.1971
25	0.7798	0.6095	0.4776	0.3751	0.2953	0.2330	0.1842
26	0.7720	0.5976	0.4637	0.3607	0.2812	0.2198	0.1722
27	0.7644	0.5859	0.4502	0.3468	0.2678	0.2074	0.1609
28	0.7568	0.5744	0.4371	0.3335	0.2551	0.1956	0.1504
29	0.7493	0.5631	0.4243	0.3207	0.2429	0.1846	0.1406
30	0.7419	0.5521	0.4120	0.3083	0.2314	0.1741	0.1314
35	0.7059	0.5000	0.3554	0.2534	0.1813	0.1301	0.0937
40	0.6717	0.4529	0.3066	0.2983	0.1420	0.0972	0.0668
45	0.6391	0.4102	0.2644	0.1712	0.1113	0.0727	0.0476
50	0.6080	0.3715	0.2281	0.1407	0.0872	0.0543	0.0339

[1/] Prepared by R. B. How, Department of Agricultural Economics, Cornell University.



A PROBLEM

FOR YOU

WITH 10% DISCOUNT

RATE

WHAT IS THE PRESENT

VALUE OF PRECEIVING

$100 EACH YEAR FOR

THE NEXT 5 YEARS?

YEAR	AMOUNT RECEIVED		PRESENT VALUE FACTOR	PRESENT VALUE
1	$100	X		
2	100	X		
3	100	X		
4	100	X		
5	100	X		

YOUR
ANSWER

= $90.91

= 82.64

= 75.13

= 68.30

= 62.09

.9091

.8264

.7513

.6830

.6209

TOTAL

$379.07

YEAR	AMOUNT	DISCOUNT FACTOR	PRESENT VALUE
1	$-1,000	.9091	$-909.10
2	1,000	.8264	826.40
3	1,000	.7513	751.30
4	-1,000	.6830	-683.00
5	-1,000	.6209	620.90
			$ 606.50

NET PRESENT VALUE

DISCOUNT ALL CASH FLOWS

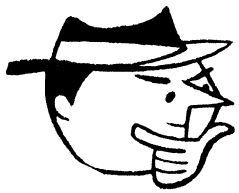
(POSITIVE & NEGATIVE)

WHICH DISCOUNT RATE ?

NPV + = YES

NPV 0 = ?

NPV - = NO



SHOULD I MAKE THE INVESTMENT ?

CALCULATING MEASURES OF WORTH

AN EXAMPLE

AFTER-TAX CASH FLOWS FOR THREE INVESTMENTS

YEAR	INV. A	INV. B	INV. C
0	$-20,000	$-20,000	$-20,000
1	2,000	5,800	4,000
2	4,000	5,800	10,000
3	6,000	5,800	10,000
4	8,000	5,800	3,000
5	10,000	5,800	1,000

PAYBACK PERIOD

$$P = \frac{I}{E}$$

WHERE:

P = PAYBACK PERIOD (YEARS)

I = CAPITAL

E = NET CASH PER YEAR

PAYBACK PERIOD

FORMAL - SIMPLE - COMMONLY USED

DEFINE: YEARS TO RECOVER INVESTMENT

USE: REJECT IF EXCEEDS MAXIMUM ACCEPTABLE

FORMULA: $$P = \frac{I}{E}$$

WHERE: P = PAYBACK PERIOD (YRS.)
I = INVESTMENT
E = ADDED ANNUAL AVERAGE AFTER-TAX NET CASH

SUPPORTS

DISCOUNTING EFFECT OF UNCERTAINTY AND TIME

TIMING OF CASH FLOW IS IMPORTANT

PROBLEMS

NO CONSIDERATION OF TIMING DIFFERENCES

PRIOR TO PAYBACK
AFTER PAYBACK

CAN LEAD TO WRONG DECISIONS

PAYBACK PERIOD FOR INVESTMENTS

AFTER-TAX CASH FLOWS FOR THREE INVESTMENTS

YEAR	INV. A	INV. B	INV. C
0	$-20,000	$-20,000	$-20,000
1	2,000	5,800	4,000
2	4,000	5,800	10,000
3	6,000	5,800	10,000
4	8,000	5,800	3,000
5	10,000	5,800	1,000
Payback Period (YEARS)	4	3.4	2.6

RATE - OF - RETURN

$$R = \frac{P}{I} \times 100$$

WHERE:

R = AVERAGE RATE OF RETURN (%)

P = AVERAGE ANNUAL PROFIT

I = CAPITAL INVESTMENT

RETURN ON INVESTMENT

SIMPLE - EASY TO USE - COMMONLY USED

DEFINE: AVERAGE ANNUAL NET INCOME (AFTER DEPRECIATION) AS PERCENT OF INVESTMENT

FORMULA: $$R = \frac{E - D}{I}$$

WHERE: R = RATE OF RETURN

E = ADDED ANNUAL AVERAGE AFTER-TAX NET CASH

D = DEPRECIATION

I = INVESTMENT (INITIAL OR AVERAGE)

SUPERIOR TO PAYBACK

CONSIDERS LIFE OF ASSET

WEAKNESSES

RATE NOT COMPARABLE

FAILS TO CONSIDER TIMING

CAN LEAD TO WRONG DECISION

RATE OF RETURN FOR THREE INVESTMENTS

PROJECT	TOTAL CASH RETURNS	TOTAL DEP.	AVERAGE ANNUAL PROFIT	RATE OF RETURN
A	$30,000	$20,000	$2,000	10%
B	29,000	20,000	1,800	9%
C	28,000	20,000	1,600	8%

NPV METHOD: I PREDETERMINED
SOLVE FOR NPV
SINGLE SOLUTION

IRR METHOD: NPV = 0
SOLVE FOR I
TRIAL AND ERROR
LINEAR INTERPOLATION
MULTIPLE SOLUTIONS (I)

BOTH METHODS
- RESULT IN CORRECT ANSWERS
- EVALUATE INDIVIDUAL PROJECTS
- RANK ALTERNATIVE PROJECTS
- CONSIDERS
  - COST OF CAPITAL
  - RISK
  - UNCERTAINTY
  - INFLATION
  - PROFITABILITY
  - FEASIBILITY

NPV SUPERIOR
- EASIER
- FEWER PROBLEMS
- WEIGHTED VALUE OF INVESTMENT WORTH

DISCOUNTED CASH FLOWS

ADVANTAGES

- CONSIDER TIMING OF CASH FLOWS
- MEANINGFUL CUT-OFF CRITERION

METHODS

- NET PRESENT VALUE
- INTERNAL RATE OF RETURN

BOTH METHODS

- SAME FORMULA
- SAME CASH FLOW
- SAME MINIMUM RATE

FORMULA:

$$NPV = -I + \frac{E_1}{1 + I} + \frac{E_2}{(1 + I)^2} + \ldots + \frac{E_N}{(1 + I)^N} + \frac{E_S}{(1 + I)^N}$$

WHERE:
- NPV = NET PRESENT VALUE
- I = INVESTMENT
- E_N = ANNUAL AFTER-TAX CASH FLOW
- E_S = SALVAGE VALUE
- I = DISCOUNT RATE

NET PRESENT VALUE

(DISCOUNTED CASH FLOW)

$$NPV = R_0(F_{I0}) + R_1(F_{I1}) + R_2(F_{I2}) \ldots\ldots R_N(F_{IN})$$

WHERE:

NPV = NET PRESENT VALUE

R_0 = NET CASH FLOW IN PERIOD 0 = CAPITAL INVESTED

R_1 = NET CASH FLOW IN PERIOD 1

R_2 = NET CASH FLOW IN PERIOD 2

.
.
.
.
.

R_N = NET CASH FLOW IN PERIOD N

F_{I0} = DISCOUNT FACTOR FOR I IN PERIOD 0 = 1

F_{I1} = DISCOUNT FACTOR FOR I IN PERIOD 1

F_{I2} = DISCOUNT FACTOR FOR I IN PERIOD 2

.
.
.
.
.

F_{IN} = DISCOUNT FACTOR FOR IN PERIOD

I = DISCOUNT RATE (%)

N = LIFE OF INVESTMENT (YEARS)

IF: NPV + MAKE INVESTMENT
NPV 0 QUESTIONABLE —
NPV — DO NOT MAKE INVESTMENT

NET PRESENT VALUE OF INVESTMENT A

COST OF CAPITAL - 8%

YEAR	DISCOUNT FACTOR	CASH FLOW	PRESENT VALUE
0	1.0000	$-20,000	$-20,000
1	.9259	2,000	1,852
2	.8573	4,000	3,429
3	.7938	6,000	4,763
4	.7350	8,000	5,880
5	.6806	10,000	6,806
NPV			$2,730

COMPARING RESULTS FOR INVESTMENTS

MEASURE OF WORTH	INV. A	INV. B	INV. C
RATE OF RETURN	10%	9%	8%
PAYBACK	4	3.4	2.6
NET PRESENT VALUE			
i = 4	$6,013	$5,820	$4368
i = 6	4,294	4,432	4,593
i = 8	2,730	3,277	3,101